International Journal of Engineering Research & Management Technology ISSN: 2348-4039
July-2015 Volume 2, Issue-4
Email: editor@ijermt.org www.ijermt.org

Extraction of Color and Texture Features of an Image

Neha Rawat
Department of ECE
Kurukshetra University, Haryana

Mr. Amit Mahai
Department of ECE
Kurukshetra University, Haryana

ABSTRACT:
CBIR or Content Based Image Retrieval is the retrieval of images based on visual features such as colour, texture and shape. In this paper we outlined how the features of an image are extracted and used as the basis for the similarity check between the images.

KEY WORDS: Method of Representation, Distance Formula, Feature Extraction, Feature Matching, Picture Formats

INTRODUCTION:
Content-based image retrieval (CBIR), also known as query by image content (QBIC) and content-based visual information retrieval (CBVIR) is the application of computer vision to the image retrieval problem, that is, the problem of searching for digital images in large databases "Content-based" means that the search will analyze the actual contents of the image. The term 'content' in this context might refer colors, shapes, textures, or any other information that can be derived from the image itself. Without the ability to examine image content, searches must rely on metadata such as captions or keywords. Such metadata must be generated by a human and stored alongside each image in the database.

DEFINITION:
CBIR or **Content Based Image Retrieval** is the retrieval of images based on visual features such as colour, texture and shape. Reasons for its development are that in many large image databases, traditional methods of image indexing have proven to be insufficient, laborious, and extremely time consuming. In CBIR, each image that is stored in the database has its features extracted and compared to the features of the query image. It involves two steps

FEATURE EXTRACTION:
The first step in the process is extracting image features to a distinguishable extent.

MATCHING:
The second step involves matching these features to yield a result that is visually similar.

COLOR:
One of the most important features that make possible the recognition of images by humans is color. Color is a property that depends on the reflection of light to the eye and the processing of that information in the brain. We use color everyday to tell the difference between objects, places, and the time of day. Usually colors are defined in three dimensional color spaces. These could either be RGB (Red, Green, and Blue), HSV (Hue, Saturation and Value) or HSB (Hue, Saturation, and Brightness). The last two are dependent on the human perception of hue, saturation, and brightness. Most image formats such as JPEG, BMP, GIF, use the RGB color space to store information. The RGB color space is defined as a unit cube with red, green,

and blue axes. Thus, a vector with three co-ordinates represents the color in this space. When all three coordinates are set to zero the color perceived is black. When all three coordinates are set to 1 the co perceived is white. The other color spaces operate in a similar fashion but with a different perception.

METHOD OF REPRESENTATION (COLOR HISTOGRAM):

The main method of representing color information of images in CBIR systems is through color histograms. A color histogram is a type of bar graph, where each bar represents a particular color of the color space being used. Color histogram of an image can be represented in the RGB or HSV color space. The bars in a color histogram are referred to as bins and they represent the x-axis. The y-axis denotes the number of pixels there are in each bin. By default the number of bins represented in an image's colour histogram using the imhist() function in Mat Lab is 256. We use Global color histograms in extracting the color features of images.

QUADRATIC DISTANCE METRIC:

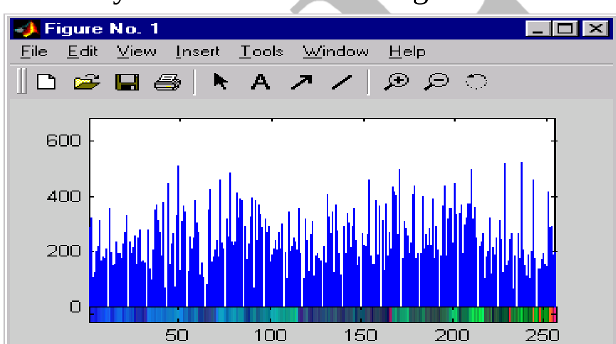
The equation we used in deriving the distance between two colour histograms is the quadratic distance metric:

$$d^2(Q,I) = (H_Q - H_I)^t A(H_Q - H_I)$$

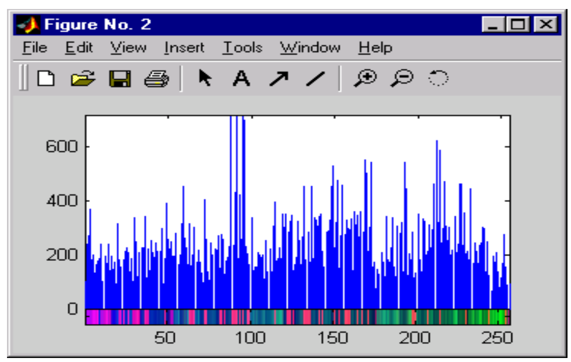
The first term consists of the difference between two colour histograms; or more precisely the difference in the number of pixels in each bin. This term is obviously a vector since it consists of one row. The number of columns in this vector is the number of bins in a histogram. The third term is the transpose of that vector. The middle term is the similarity matrix. The final result d represents the colour distance between two images. The closer the distance is to zero the closer the images are in colour similarity. The further the distance from zero the less similar the images are in colour similarity.

Similarity Matrix

The color histograms of two images Q and I in the figure below, the color patterns observed in the color bar are totally different. Color Histogram of two Images



(a) Image Q

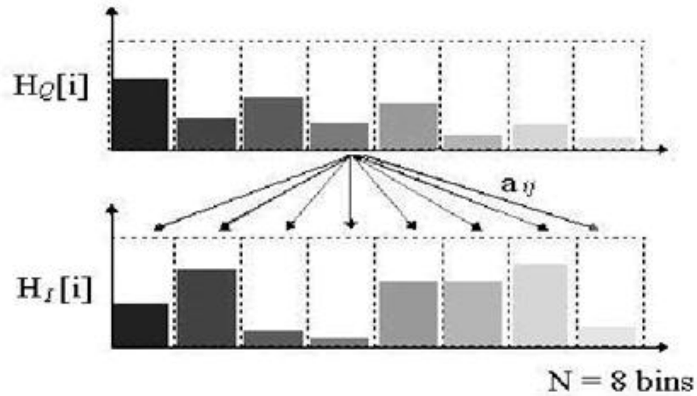


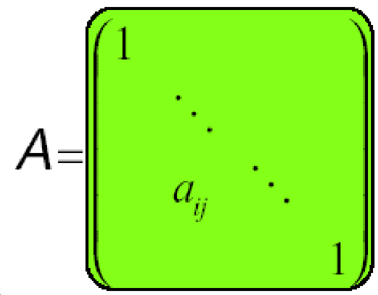
(b) Image I

COLOR MAP OF TWO IMAGES

Color Map of image Q		
0.9608	0.8980	0.7843
0.9373	0.9059	0.8235
0.9098	0.8510	0.7765
0.9255	0.8588	0.8039
0.8627	0.8275	0.7961

Color Map of image I		
0.9922	0.9882	0.9961
0.9569	0.9569	0.9882
0.9725	0.9647	0.9765
0.9176	0.9137	0.9569
0.9098	0.8980	0.9176





This is continued until we have compared all the colour bins of HQ. In doing so we get an N x N matrix, N representing the number of bins. What indicates whether the colour patterns of two histograms are similar is the diagonal of the matrix, shown below. If the diagonal entirely consists of ones then the colour patterns are identical. The further the numbers in the diagonal are from one, the less similar the colour patterns are. Thus the problem of comparing totally unrelated bins is solved.

RESULT:

After obtaining, similarity matrix, and colour histogram differences, for a number of images in our database, we implemented the results in the final equation, Quadratic Distance Metric. Surprisingly a number of inconsistencies kept appearing in terms of the colour distances between certain images. Images that where totally unrelated had colour distances smaller than those that where very similar. Example can be seen with the following three images: a mosque, a hockey game, and another picture of the same hockey game, as seen below


(a) Fig 1


(b) Fig 2


(c) Fig 3

FIGURE: TESTED IMAGES:

Images	Color distance between image histograms
Fig 1 vs Fig 2	10.77
Fig 1 vs Fig 3	9.99

This was done again and again with number of images, and resulted in the same inconsistencies. The cause for this was the type of images we were using. The reason for inconsistent result can be the comparison of images of different sizes, but resizing all the images in our database to 256x256 before testing our algorithm does not work. The images we had in our database where all 24-bit JPEGs. The problem with JPEG images is that they are compressed and the compression algorithm seems to affect the way the histograms are derived. We found this out by converting some of the images in our database to 8-bit uncompressed bit maps. The same images that were tested in JPEG format were tested again as BMPs. The results were consistent. Images that looked similar gave small color distances compared to those that looked very different. This can be seen in the following table, which shows the same images as those in the previous table but in BMP format.

Images	Color distance between image histograms
Fig 1 vs Fig 2	4.39
Fig 1 vs Fig 3	6.10

The error was due to image format, so requires conversion of our images to uncompressed BMPs. This obviously is not consistent with full CBIR systems available in the market.

TEXTURE:

Texture property of surface that describes visual patterns, each having properties of homogeneity. It contains information about the structural arrangement of the surface, such as; clouds, leaves, bricks, fabric, etc. Texture properties include: Coarseness, Contrast, Directionality, Regularity, and Roughness. Texture is characterized by the spatial distribution of gray levels in a neighbourhood. In order to capture the spatial dependence of gray-level values, which contribute to the perception of texture, a two-dimensional dependence texture analysis matrix is taken into consideration. This two-dimensional matrix is obtained by decoding the image file; jpeg, bmp, etc.

METHOD OF REPRESENTATION:

There are three principal approaches used to describe texture:

STATISTICAL TECHNIQUES:

Characterize textures using the statistical properties of the grey levels of the points/pixels comprising a surface image. These properties are computed using: the grey level co-occurrence matrix of the surface, or the wavelet transformation of the surface

STRUCTURAL TECHNIQUES:

Characterize textures as being composed of simple primitive structures called "texels" (or texture elements). These are arranged regularly on a surface.

SPECTRAL TECHNIQUES:

Based on properties of the Fourier spectrum and describe global periodicity of the grey levels of a surface by identifying high-energy peaks in the Fourier spectrum.

EUCLIDEAN DISTANCE

Euclidean Distance Algorithm:

1. Decompose query image.
2. Get the energies of the first dominant k channels.
3. For image i in the database obtain the k energies.
4. Calculate the Euclidean distance between the two sets of energies, using [2]:

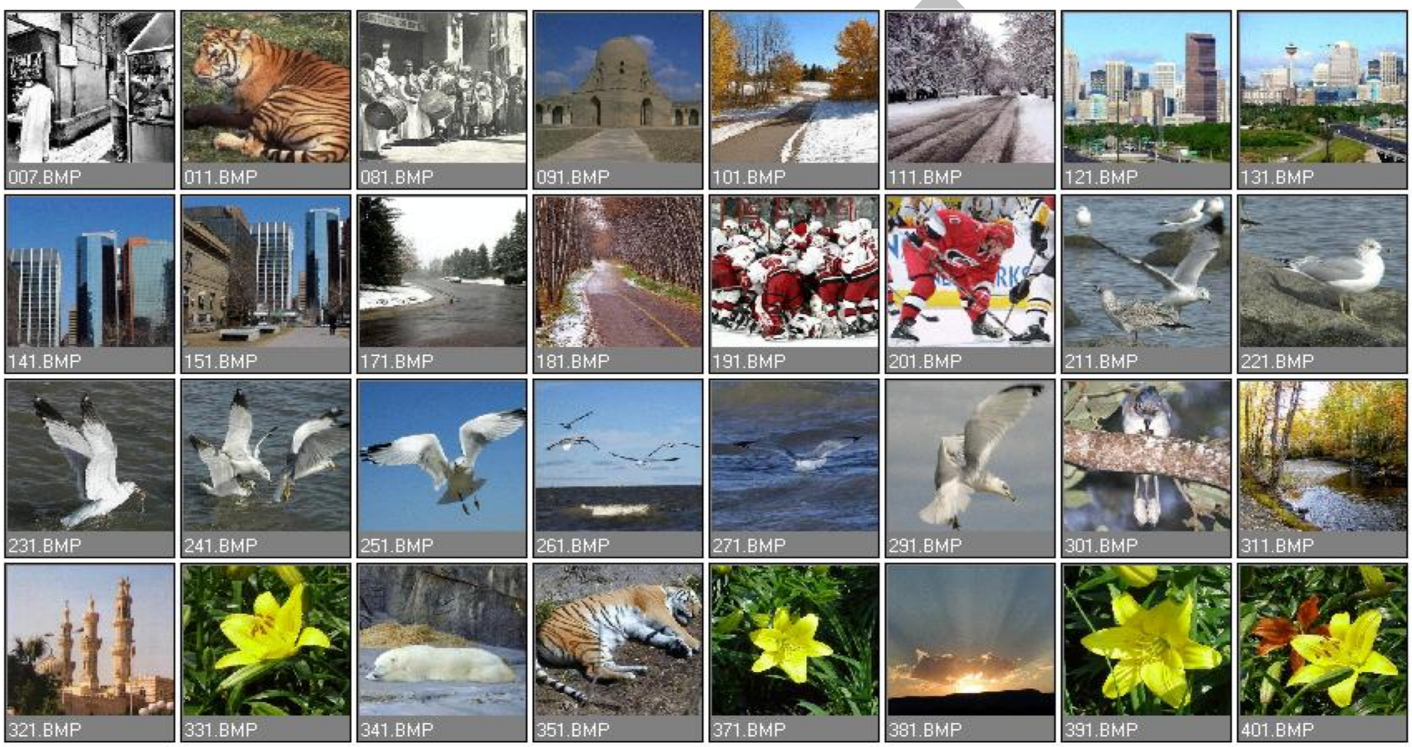
$$D_i = \sum_{k=1}^{k} \left(x_k - y_{i,k} \right)^2$$

5. Increment i. Repeat from step 3.

Using the above algorithm, the query image is searched for in the image database. The Euclidean distance is calculated between the query image and every image in the database. This process is repeated until all the images in the database have been compared with the query image. Upon completion of the Euclidean distance algorithm, we have an array of Euclidean distances, which is then sorted. The five topmost images are then displayed as a result of the texture search.

DATABASE:

The image database that we used in our project contains sixty 8-bit uncompressed bit maps BMPs that have been randomly selected from the World Wide Web. The following figure depicts a sample of images in database



(a)Image Database

To demonstrate the application, we implemented the following example:

1. We started the application by typing a Demo and pressing return in the Mat Lab Command Window. The application window started.
2. In the application window, we selected the Options menu, and selected Search Database. This enabled the browsing window, to browse to a BMP file.
3. Upon highlighting a BMP file, the select button became enabled. Note: Only 8-bit uncompressed BMPs are suitable for this application. In this example, we selected 371.bmp.
4. The highlighted BMP is then selected by pressing the Select button.
5. Next, pressing the Search button started the search.

Figure: The query image: 371.bmp…

TEXTURE EXTRACTION AND MATCHING:

Using the texture feature extraction algorithm described above, where the energies of the query image and the colour result images' sub-bands are compared using the Euclidean Distance Metric, we obtained the following top 4 results:

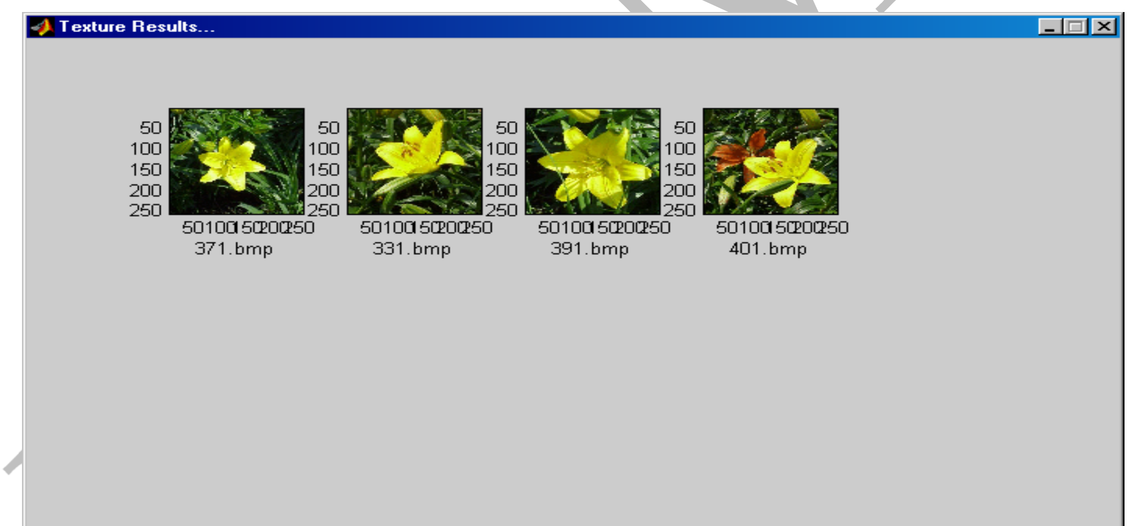


Figure: Texture Results for the searching for 371.bmp

The above results are sorted according to the Euclidean distance… These are shown below:

File Name	Euclidean Distance
371.bmp	0
331.bmp	1.1449
391.bmp	2.4609
401.bmp	2.6926

Table: Euclidean distance between query and results

By observing the images in our database, we can actually say that the above results represent the closest matches to the query image chosen.

ABBREVIATIONS AND ACRONYM:

CBIR – Content Based Image Retrieval
JPEG- Joint Picture Expert Group
RGB- Red Green Blue
HSV- Hue, Saturation and Value
HSB- Hue, Saturation and Brightness

CONCLUSION:

CBIR is still a developing science. The dramatic rise in the sizes of images databases has stirred the development of effective and efficient retrieval systems. The development of these systems started with retrieving images using textual connotations but later introduced image retrieval based on content. This came to be known as CBIR or Content Based Image Retrieval. Systems using CBIR retrieve images based on visual features such as colour, texture and shape, as opposed to depending on image descriptions or textual indexing. In this project, we have researched various modes of representing and retrieving the image properties of colour, texture and shape. Existing techniques shows good results only on small dataset but accuracy decreases considerably on large dataset. In this project, we have researched various modes of representing and retrieving the image properties of color, texture and shape. The application performs a simple color-based search in an image database for an input query image, using color histograms. It then compares the color histograms of different images using the Quadratic Distance Equation. Further enhancing the search, the application performs a texture-based search in the color results, using wavelet decomposition and energy level calculation. It then compares the texture features obtained using the Euclidean Distance Equation.

REFERENCES:

JOURNAL PAPERS:

1. Aibing Rao, etc., Spatial Color Histograms for Content-Based Image Retrieval, Proceedings of the 11-th IEEE International Conference on Tools with Artificial Intelligence pages 183-186, Nov. 9, 1999.
2. Nuno Vasconcelos and Andrew Lippmann, "A Probabilistic Architecture for Content-based Image Retrieval", Proc.,IEEE Conference Computer Vision and Pattern Recognition, Hilton Head, North Carolina, 2000.
3. P.S.Suhasini, Dr. K.Sri Rama Krishna, Dr. I. V. Murali Krishna, "CBIR Using Color Histogram Processing", Journal of Theoretical and Applied Information Technology2005.
4. S. Nandagopalan, Dr. B. S. Adiga, and N. Deepak, "A Universal Model for Content-Based Image Retrieval", International Journal of Computer Science, **4:4**, 2009.
5. M. Braveen, P. Dhavachelvan, "Evaluation of Content Based Image Retrieval Systems Based on Color Feature", International Journal of Recent Trends in Engineering, 1, No. 2, May 2009.

BOOKS:

1. Oge Marques and Borko Furht, Content based image and video retrieval (Springer- Kluwer Academic Publishers, 2002)
2. Ahmed J. Afifi and Wesam Ashour, Image retrieval based on content using color feature (LAP Lambert Academic Publishing, 2011)
3. Smita Das and Dwijen Rudrapal, Content based image retrieval method : Based on low level features (LAP Lambert Academic Publishing, 2012)